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ABSTRACT

This paper reviews the communicative behavior surrounding the coordination of expert and "semi-expert" groups of scientists and engineers by analyzing several histories of technology that focus on the coordination of research information between a research organization and many development organizations. For the paper's purposes, semi-expert means the members of groups who are more than novices--they possess specialized training and experience in closely related work and they know enough of the language of their fellow researchers to communicate with them. The paper looks only at descriptions of problems and actions related to person-to-person contact in the settings, reviewing histories which describe the vast network of British Cooperative Research Associations that spanned the late 19-teens until well into the 1960s. The paper finds that liaisons, trainers, conferences, open houses, and social occasions were methods in which communication was practiced and encouraged. It discusses these methods. Contains 26 footnotes. (NKA)

Spanning the Research/Application Interface: Liaisons and Trainers as Agents Bridging Expert and Semi-Expert Discourses

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Most technological products are not able to be designed or produced by a single scientist or engineer working alone. Rather, scientists and engineers frequently work in teams on smaller, more manageable, parts of the entire problem they are attempting to solve. Their work is not done in isolation from their colleagues; but rather, as Frederick Williams and David Gibson have pointed out, it is saturated with communication—among and between dyads, triads, small groups, and larger organizations.[1] Some of the communication among these groups serves to coordinate the work of the teams attempting to solve the larger, more complex problem.

In this coordinating effort each team holds expert status within the domain of the smaller problem they are working on. Their expert status stems from the fact that they have information integral to the solution of the larger problem toward which their colleagues have not devoted their full attention. In other areas within the domain of the larger problem each team has a sort of semi-expertise. I use the term semi-expertise because the members of these groups are more than novices in this area—they possess specialized training and experience in closely related work and they know enough of the language of their fellow researchers to communicate with them on a significant amount of the problem space. And yet they are not quite expert either because they have not spent as much time and effort wrestling with the problem as their colleagues and because they have not fully participated in the shared language forged by the members of the expert group.

Recently, social psychologists and scholars of organizational communication have examined both the coordinating behavior among expert scientists and between expert and semi-expert scientists and engineers.[2] At the same time, related approaches to studying this coordinating effort have been taken by scholars in disciplines such as economics, information processing, sociology, and anthropology. Their approaches have focused on the act of transfer or exchange of some information or technology. In the case of technology transfer or diffusion of innovations studies, the focus has typically been on an exchange of technological artifacts; in the case of knowledge transfer studies, the focus has typically been on an exchange of information. Recently, however, these scholars are rightly recognizing a blurring of the distinction they once attempted to make between

1. Williams, Frederick, and David V. Gibson. *Technology Transfer, A Communication Perspective.* Newbury Park, Calif: Sage Publications, 1990.
2. Kraut, Robert E., Carmen Egido, and Jolene Galegher. "Patterns of Contact and Communication in Scientific Research Collaborations." in Jolene Galegher, Robert E. Kraut, and Carmen Egido (eds.) *Intellectual Teamwork. Social and Technological Foundations of Cooperative Work.* Hillsdale, New Jersey: Lawrence Erlbaum Associates. 1990.

Fowler, Priscilla, and Linda Levine. *RMA Case Study. Part I.* Technical Report from the Software Engineering Institute, Carnegie Mellon University. 1994.

technology and the knowledge and information surrounding it.[3] As scholars of rhetoric, we should be (and we have been) contributing to these discussions.[4]

These authors have employed empirical, observational, ethnographic, and case study methods to analyze the coordination among expert and semi-expert groups and they have forwarded interesting perspectives on this phenomenon. What seems to be missing from among this work, however, is a historical perspective. Historical work is valuable because it can complement existing case studies and observational studies by giving us descriptions of expert-to-semi expert communication in other contexts. As far as I have been able to determine, no histories about this phenomenon have yet been written

What I would like to do today is make a small contribution toward building histories of the communicative behavior surrounding the coordination of expert and semi-expert groups of scientists and engineers by analyzing several histories of technology that focus on the coordination of research information between a research organization and many development organizations. My hope is that an analysis of these descriptions will complement our existing knowledge of this phenomenon and illustrate the existence of a rich archive for further historical studies.

For this paper, I looked only at descriptions of problems and actions related to person-to-person contact in these settings. Because of time constraints, I am not able to discuss publications and other mechanisms used to cross organizational boundaries in coordinating the work of scientists and engineers, but this may be a source for future work. The histories I reviewed described the vast network of Cooperative Research Associations in Britain that spanned the late 19-teens until well into the 1960s. The historians writing these histories used archival data as well as data from surveys and interviews of cooperative research association directors and their senior staffs.

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3. Examples include:

Nelson, R.R. "The Simple Economics of Basic Scientific Research." *Journal of Political Economy.* pp. 297-306. 1959.

Arrow, K.J. "Economic Welfare and the Allocation of Resources for Invention." In Universities-National Bureau Committee for Economic Research, *The Rate and Direction of Inventive Activity.* Princeton, NJ: Princeton University Press. 1962.

Rogers, Everett. *Diffusion of Innovation.* Lexington. 1983.

Kevles, Daniel J. "R&D and the Arms Race: An Analytical Look." in E. Mendelsohn, M.R. Smith, and P. Weingart (eds.). *Science, Technology and the Military,* Volume XII, 1988. pp. 465-480.

Mowery, D.C., and N. Rosenberg. *Technology and the Pursuit of Economic Growth.* New York, NY: Cambridge University Press. 1989.

Doheny-Farina. *Rhetoric, Innovation, Technology. Case Studies of Technical Communication in Technology Transfers.* MIT Press. Cambridge, Massachusetts. 1992.

4. Examples include Doheny-Farina. *Rhetoric Innovation, Technology. Case Studies of Technical Communication in Technology Transfers.* MIT Press. Cambridge, Mass. 1992; and Killingsworth, M. Jimmie and Michael K. Gilbertson. *Signs, Genres, and Communities in Technical Communication.* Baywood-Technical Communication Series. Jay R. Gould (ed.). Amityville, NY: Baywood Publishing Company, Inc. 1992.

Cooperative Research Associations

First, let me give you a little background on the cooperative research associations. By the eve of World War I, England had become heavily dependent on Germany for its manufacturing. After the onset of the war, Britain cancelled its trade with Germany and it was left lacking a source for some manufactured materials and much manufacturing expertise.[5] By 1916, as a response to this situation, the British Government founded a series of semi-private, cooperative research associations. These associations were asked to foster cooperative research activities in the industries they served and to coordinate their research together into a "national research plan."[6] The support for the research associations came from "subscriptions" or contributions of the individual firms served by the research associations and grants from the British Government.[7] Initially, 22 research associations were formed for industries such as the automobile, textile, and electrical industries. Membership in the associations was voluntary and the members set up mechanisms to regulate the associations. Initially, membership grew rapidly—In just four years, 2,500 firms had joined research associations. By the end of 1920, however, memberships dropped off because of a severe drop in prices in Britain, the lack of demonstrated results from the research of these associations, and poor management in the case of some. Several associations were forced to close at this time. However, from 1920 to the mid-1930s, 11 new cooperative research associations were added and by 1929, the cooperative research associations were beginning to produce commercially viable results leading to improvements in products and processes of the industries they served.[8] Most of these associations continued to conduct research for their industries well into the 1970s. And, by 1962, most major European countries and the U.S. had established research associations as well.[9]

Problems

Next I'd like to illustrate two problems faced by research associations communicating technical information: the large distance between the research association and subscribers, and the subscribers' fears that researchers would disclose information considered confidential by the subscriber.

Proximity

In some cases, the research associations and their subscribers were widely scattered. These associations have long struggled with problems of miscommunication, mistrust, and delays in their communication across organizational boundaries.[10] Because of this, several research associations

5. Edwards, Ronald S. *Co-Operative Industrial Research. A Study of the Economic Aspects of the Research Associations grant-aided by the Department of Scientific and Industrial Research.* London: Sir Isaac Pitman & Sons, Ltd.
6. Varcoe, Ian. "Co-operative Research Associations in British Industry, 1918-1934." *Minerva.* v.19. 1981.
7. Edwards, Ronald S.
8. Varcoe, Ian.
9. Johnson, P.S. *Co-operative Research in Industry.* New York, NY: Halsted Press. John Wiley and Sons. 1973. In the rest of Europe, they were called research associations and in the U.S. they were called cooperative research organizations.

located themselves in the same region that their subscribers were clustered. Examples of these research associations were the Cotton Research Association in Manchester, the Wool Research Association in Leeds, and the Linen Research Association in Belfast.[11] In a few cases, research associations set up satellite locations near other clusters of firms in that industry.[12]

Confidentiality

Another problem is pointed out in a 1947 survey of subscribing firms where executives reported a fear of disclosing information about their future development plans to the members of the research associations because they feared the researchers would disclose that information to their peers or to other subscribers. Many directors of the research associations in the same survey also were opposed to their researchers entering into confidential research agreements because they would not be able to publish that work. Because of the aversion to confidential research among both organizations, the communication among some researchers and developers was somewhat restricted.[13] So the two main problems faced by research associations in coordinating their work with developers were problems of increased distance and a fear of the disclosure of sensitive information.

Actions

In an attempt to solve the problem of geographical separation and an additional problem in which the research associations discovered that the subscribing firms were unaware of the research done by the research association or other researchers in the same field, the research associations employed several mechanisms designed to bring individuals in each organization together.

Liaisons

In the late 1920s, the Cotton Research Association and the Launderers' Research association were not able to support the number of scientific staff they felt they required. Also, their subscribers consisted of many small firms who could not afford to hire researchers who could interpret the research reports published by these research associations. These firms struggled to understand the work of the research associations and it was only after representatives from these associations met with people in the subscribers' organizations that they were able to understand the research.

In response to this situation, the Cotton and Launderers' Research Associations began the practice of employing liaison officers whose job was to be familiar with the results of their association's research and the research of their field. They were expected to visit the subscriber (on their own initiative or on the initiative of the subscriber), tour any labs the subscribers might have and talk to their development staff. In their visits, they were to suggest ways the subscribers could employ the latest research in their field. It was also common for the subscribing firms to request that liai-

10.Varcoe, Ian.

11.Edwards, Ronald S. and Edgerton, D.E.H. "Science and Technology in British Business History." in *Enterprise, Management and Innovation in British Business*. and Edgerton.

12.Edwards, Ronald S.

13.Edwards, Ronald S.

sons make a visit as needed by the subscribing firm. While at the subscriber's site, the liaisons were asked to listen to the developers to understand the problems their organizations faced. When they had a chance to travel back to the research association, they were asked to meet with researchers and tell them of the problems the subscribers were having.

Some liaisons were "on-the-road" nearly all the time, and returned occasionally to listen to progress reports made by the research staff. Other liaisons remained at the research association for the majority of their time, visiting subscribers only occasionally.[14] Some subscribers were visited only once a year while others were visited quite frequently.[15]

The popularity of liaisons in the initial research associations using them caused other research associations to take note. Soon nearly all of them were employing liaisons. The liaisons who seemed to be the most successful were those whose subscribers were in "craft" industries where the average size of the subscribing firm was small.[16] As the liaisons' popularity grew, other members of research associations, such as directors, their senior staffs, and researchers began to regularly spend some part of their time visiting subscribers and hosting members of subscribing firms.[17]

A survey taken in 1947 of 190 managers in subscribing firms found that 102 firms considered liaison visits useful and 41 thought that they produced no useful results. Favorable comments from the subscribers spoke of engineers in the subscribers' firms enjoying lively discussions with liaisons on research problems. The subscribers also appreciated the personal contact with a member of the research association. The presence of liaisons was linked to helping the subscribers' engineers in seeing problems from new perspectives and in getting the feeling that their problems were being understood by someone in the research association. The surveyor received very few negative comments, but those comments were that liaison visits were unproductive and in some cases, the subscribers felt that the liaisons had learned more from their staff than they had learned from the liaison.

A few firms complained that they feared that liaison officers would pass on confidential information to the next firm they visited. However 145 out of 183 responded that they weren't worried about the liaison passing on confidential information. The reasons given for their worry was that the liaison could see all of their secrets when he visited the subscriber's site. The reasons given by those not worried were either that they were confident they could keep ahead of their competition should disclosure happen or they felt the benefits of exchange outweighed the risk of exposure.[18]

14.Edwards, Ronald S.
15.Johnson, P.S.
16.Edwards, Ronald S.
17.Johnson, P.S.
18.Edwards, Ronald S.

Trainers

Another way research associations attempted to facilitate the sharing of research information among expert and semi-expert groups was to provide training services for their subscribers. Whereas the liaisons attempted to establish an ongoing relationship with the subscribers, trainers developed courses following a pre-determined curriculum that were delivered in a short period of time. Some research associations hosted training at universities, while others, like the Hosiery and the Printing and Packaging Associations, provided mobile lecture services—bringing the courses to the subscribers' sites. Some of the courses were developed to respond quickly to the needs of the industries, such as the work done by the Food Research Association educating subscribers after a natural disaster started the spread of disease. Other research associations offered courses for managers of subscribing firms to learn to improve their control of their work processes.[19]

Conferences

To facilitate more communication between the research associations and the subscribers, associations like the Iron and Steel, the Blast Furnace, and the Steel-Making Research Associations also held informal conferences to discuss common problems among subscribers. These conferences helped pass on research results to subscribers and they helped the research staff to get to know the needs of the members.[20] Also, the Welding Research Association used annual conferences to introduce the facilities of its research center to those subscribers who had not seen it previously, and to provide an opportunity for subscribers to consult with the research staff.[21]

Open Houses

A less formal way to facilitate interaction among subscribers and researchers was for research associations to hold open houses for their subscribers.[22] The Scientific Instruments Research Association, for example, held an open house semi-annually where they would open their laboratories to their subscribers.[23]

Social Occasions

Additionally, research associations on occasion were known to host social events where they hoped to facilitate informal contacts between industry and research association staff.[24]

19.Johnson, P.S.
20.Edwards, Ronald S.
21.Johnson, P.S.
22.Edwards, Ronald S.
23.Johnson, P.S.
24.Johnson, P.S.

Conclusion

Having explored the coordination of research and development teams in a historical context, what can we say about the coordination of expert to semi-expert work in British Cooperative Research Associations?

In this example, as the research and subscriber organizations became more and more geographically separated, more problems of misunderstanding and mistrust were associated with the communication among them. This is consistent with research on collaborative scientific work by Kraut, Egido, and Galegher.[25] One of the constraints on the communication among the researchers and subscribers was an effort on the part of both organizations in some cases to limit the discussion space between them so that information that was perceived to have strategic value would not be shared.

The boundary between expert and semi-expert organizations was mediated by a variety of communicative actions. These actions were designed to bring members of both organizations into increased contact with one another. Liaisons and other members of these organizations moved back and forth across the boundary between the two organizations in an effort to serve as an agent of the researchers to offer advice and to learn about the developers. The liaisons were the most frequent crossers of organizational boundaries in their coordinating work. They also spent the most time at the sites of the subscribers. Their physical presence as a representative of the research association was highly valued by the subscribers. The descriptions of actions of liaisons appears to be consistent with research from Gladstein and Caldwell as well as Kanter.[26]

Trainers were another type of boundary-crossing agents on behalf of the research organization. Like liaisons, they crossed over from their research organization to the subscribers' organizations. However, their visit to a subscriber was quite limited compared with liaisons and the opportunity for ongoing dialog with the members of the organizations seeking to use research knowledge was limited.

Informal conferences, seminars, open houses, and socials all served to provide a place for less formal interaction among many members of both organizations. These mechanisms provided an occasion where geographic barriers were removed and a socially acceptable schema was invoked to encourage interaction among the members of both organizations. These events were either at the site of the research association or on a site not in either the research or subscribers' sites. These mechanisms were used more frequently than the training sessions, but less frequently then interactions with liaisons.

These observations are consistent with much of the literature on social psychology and organizational communication as well as the literature on technology transfer. I believe the contribution of this study is that it complements the existing scholarship from qualitative, case study, and observational studies.

25.Kraut, R.E., J. Galegher. and C. Egido. "Relationships and tasks in scientific collaboration." *Human-Computer Interaction*. v.3. pp. 31-58. 1988.

26.Gladstein, Deborah and David Caldwell. and Kanter, Rosabeth Moss.

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